100

DESIGN FOR SUPPORTABILITY 102

Commonality 104	Modularity 106	Standards Based 108	RMT 110

• **Physical Commonality (Within the system)** 112
  • **HW Commonality**
  • Number of Unique LRUs
  • Number of Unique Fasteners
  • Number of Unique Cables
  • Number of Unique Standards Implemented
  • **SW Commonality**
  • Number of Unique SW Packages Implemented
  • Number of Languages
  • Number of Compilers
  • Average Number of SW Instantiations
  • Number of Unique Standards Implemented
• **Physical Familiarity (From other systems)** 114
  • % Vendors Known
  • % Subcontractors Known
  • % HW Technology Known
  • % SW Technology Known
• **Operational Commonality** 116
  • % of Operational Functions Automated
  • Number of Unique Skill Codes Required
  • Estimated Operational Training Time - Initial
  • Estimated Operational Training Time - Refresh from Previous System
  • Estimated Maintenance Training Time - Initial
  • Estimated Maintenance Training Time - Refresh from Previous System
	• **Physical Modularity** 118
	  • **Ease of system element upgrade**
	  • Lines of modified code
	  • Amount of labour hours for system rework
	  • **Ease of operating system upgrade**
	  • Lines of modified code
	  • Amount of labour hours for system rework
	• **Functional Modularity** 120
	  • **Ease of adding new functionality**
	  • Lines of modified code
	  • Amount of labour hours for system rework
	  • **Ease of upgrade existing functionality**
	  • Lines of modified code
	  • Amount of labour hours for system rework
	• **Orthogonality** 122
	  • Are functional requirements fragmented across multiple processing elements and interfaces?
	  • Are there throughput requirements across interfaces?
	  • Are common specifications identified?
	• **Abstraction** 124
	  • Does the system architecture provide and option for information hiding?
	• **Interfaces** 126
	  • # of Unique Interfaces per System Element
	  • # of Different Networking Protocols
	  • Explicit versus Implicit Interfaces
	  • Does the architecture involve implicit interfaces?
	  • # of Cables in the System
		• **Open Systems Orientation** 128
		  • **Interface Standards**
		  • # of Interface Standards/# of Interfaces
		  • Multiple Vendors (Greater than 5) Exist for Products Based on Standards
		  • Multiple Business Domains Apply/Use Standard (Aerospace, Medical, Telecommunications)
		  • Standard Maturity
		  • **Hardware Standards**
		  • # of Form Factors/# of LRUs
		  • Multiple Vendors (Greater than 5) Exist for Products Based on Standards
		  • Multiple Business Domains Apply/Use Standard (Aerospace, Medical, Telecommunications)
		  • Standard Maturity
		  • **Software Standards**
		  • # of proprietary & unique operating systems
		  • # of non-std databases
		  • # of proprietary middle-ware
		  • # of non-std languages
		• **Consistency Orientation** 130
		  • Common Guidelines for Implementing Diagnostics and PM/FL
		  • Common Guidelines for Implementing OMI
			• **Reliability** 132
			  • **Fault Tolerance**
			  • % of mission critical functions with single points of failure
			  • % of safety critical functions with single points of failure
			  • **Critical Points of Delicateness (System Loading)**
			  • % Processor Loading
			  • % Memory Loading
			  • How critical is this?
			  • % Network Loading
			  • How critical is this?
			• **Maintainability** 134
			  • Expected MTTR
			  • Maximum Fault Group Size
			  • Is system operational during maintenance?
			  • Accessibility
			  • Are there space restrictions?
			  • Are there special tool requirements?
			  • Are there special skill requirements?
			• **Testability** 136
			  • # of LRUs covered by BIT (BIT Coverage)
			  • Reproducibility of Errors
			  • Logging/Recording Capability
			  • Create system state at time of system failure?
			  • Online Testing
			  • Is system operational during external testing?
			  • Ease of access to external testpoints?
			  • Automated Input/Stimulation Insertion

FIG. 1

TOSEC-2024-9860

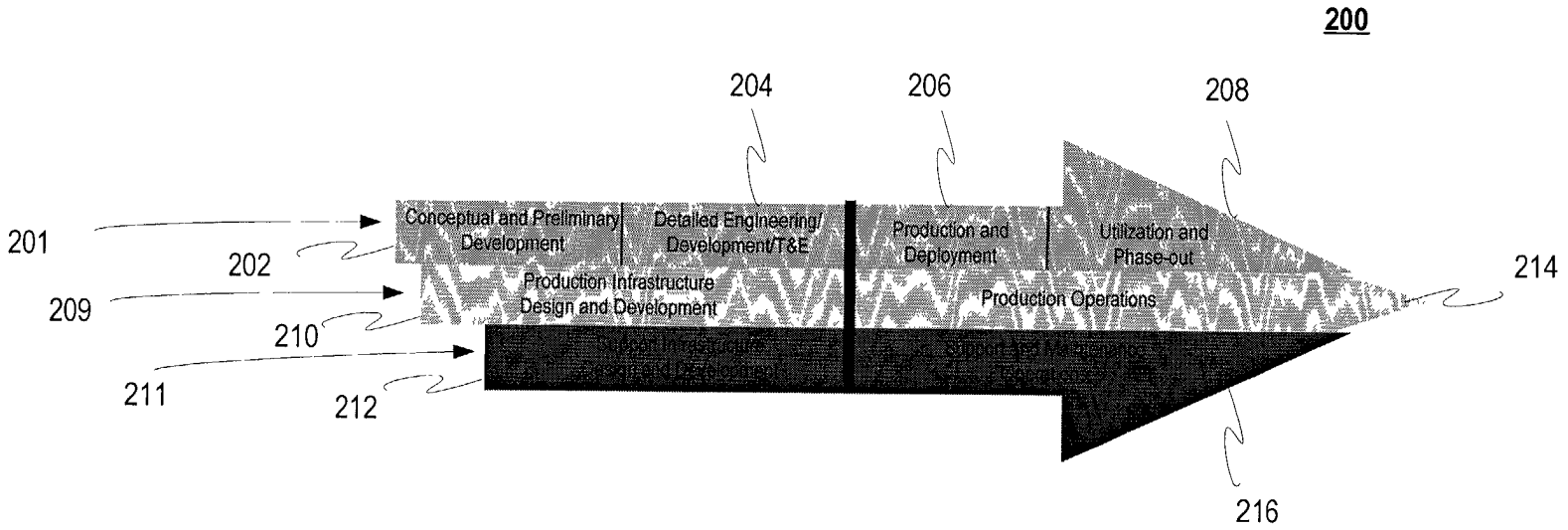

FIG. 2A

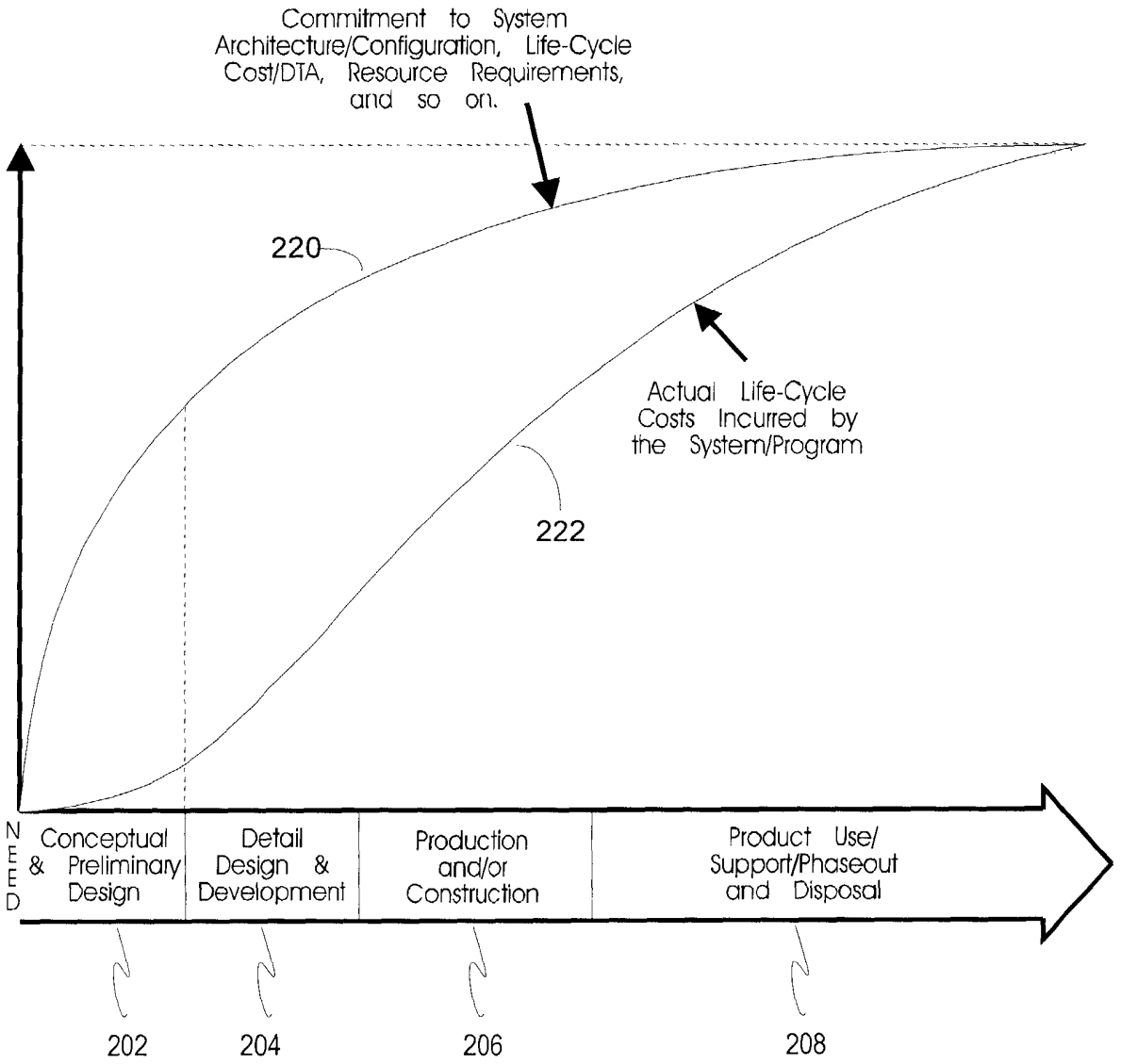
Commitment to System Architecture/Configuration, Life-Cycle Cost/DTA, Resource Requirements, and so on.
220
Actual Life-Cycle Costs Incurred by the System/Program
222
NEED
Conceptual & Preliminary Design
Detail Design & Development
Production and/or Construction
Product Use/ Support/Phaseout and Disposal
202
204
206
208

FIG. 2B

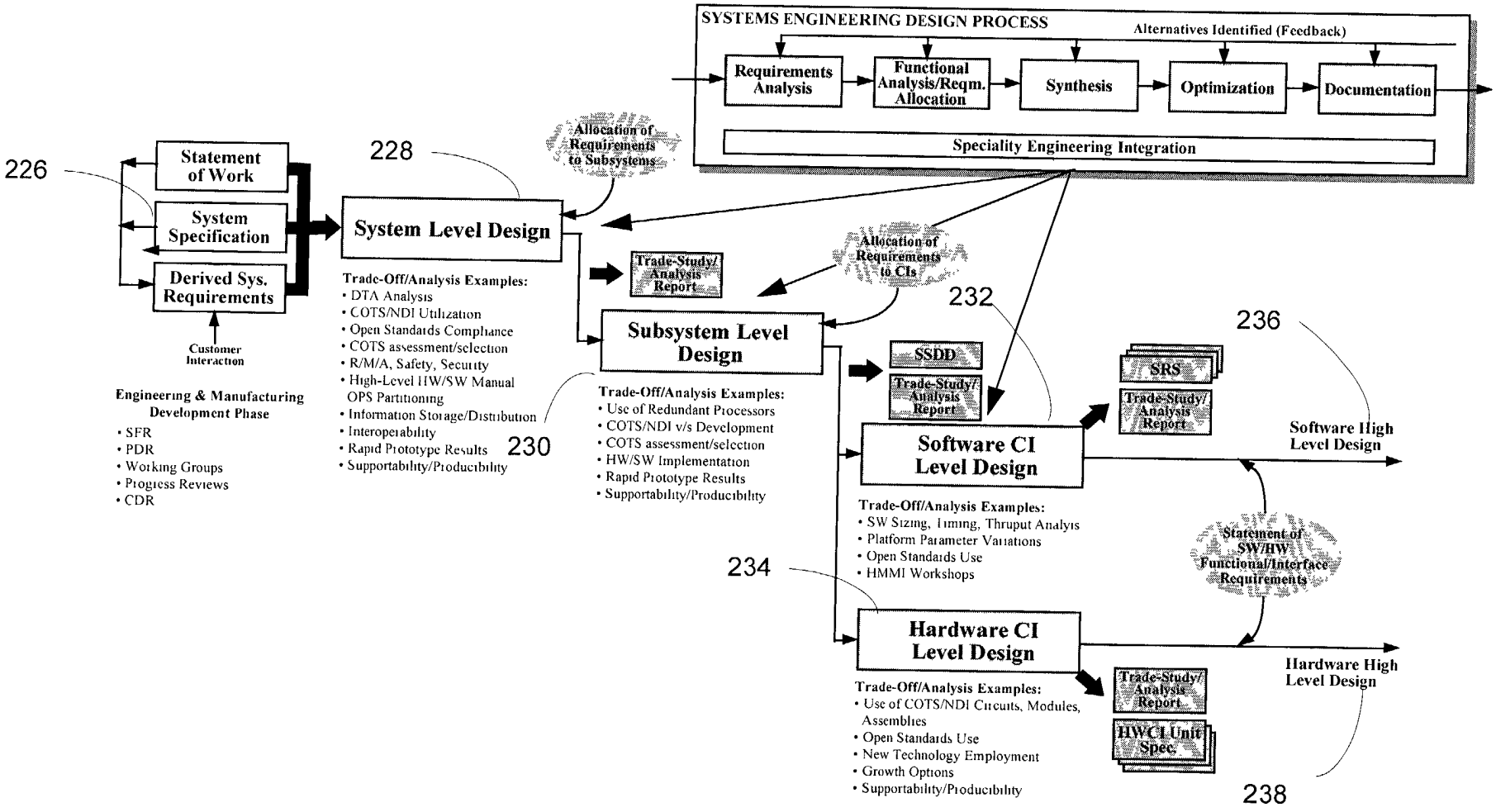
SYSTEMS ENGINEERING DESIGN PROCESS
Alternatives Identified (Feedback)
Requirements Analysis
Functional Analysis/Reqm. Allocation
Synthesis
Optimization
Documentation
Speciality Engineering Integration
226
Statement of Work
System Specification
Derived Sys. Requirements
Customer Interaction
Engineering & Manufacturing Development Phase
• SFR
• PDR
• Working Groups
• Progress Reviews
• CDR
228
Allocation of Requirements to Subsystems
System Level Design
Trade-Off/Analysis Examples:
• DTA Analysis
• COTS/NDI Utilization
• Open Standards Compliance
• COTS assessment/selection
• R/M/A, Safety, Security
• High-Level HW/SW Manual OPS Partitioning
• Information Storage/Distribution
• Interoperability
• Rapid Prototype Results
• Supportability/Producibility
Trade-Study/ Analysis Report
Allocation of Requirements to CIs
232
Subsystem Level Design
230
Trade-Off/Analysis Examples:
• Use of Redundant Processors
• COTS/NDI v/s Development
• COTS assessment/selection
• HW/SW Implementation
• Rapid Prototype Results
• Supportability/Producibility
SSDD
Trade-Study/ Analysis Report
236
SRS
Trade-Study/ Analysis Report
Software CI Level Design
Software High Level Design
Trade-Off/Analysis Examples:
• SW Sizing, Timing, Thruput Analysis
• Platform Parameter Variations
• Open Standards Use
• HMMI Workshops
Statement of SW/HW Functional/Interface Requirements
234
Hardware CI Level Design
Hardware High Level Design
Trade-Off/Analysis Examples:
• Use of COTS/NDI Circuits, Modules, Assemblies
• Open Standards Use
• New Technology Employment
• Growth Options
• Supportability/Producibility
Trade-Study/ Analysis Report
HWCI Unit Spec.
238

FIG. 2C

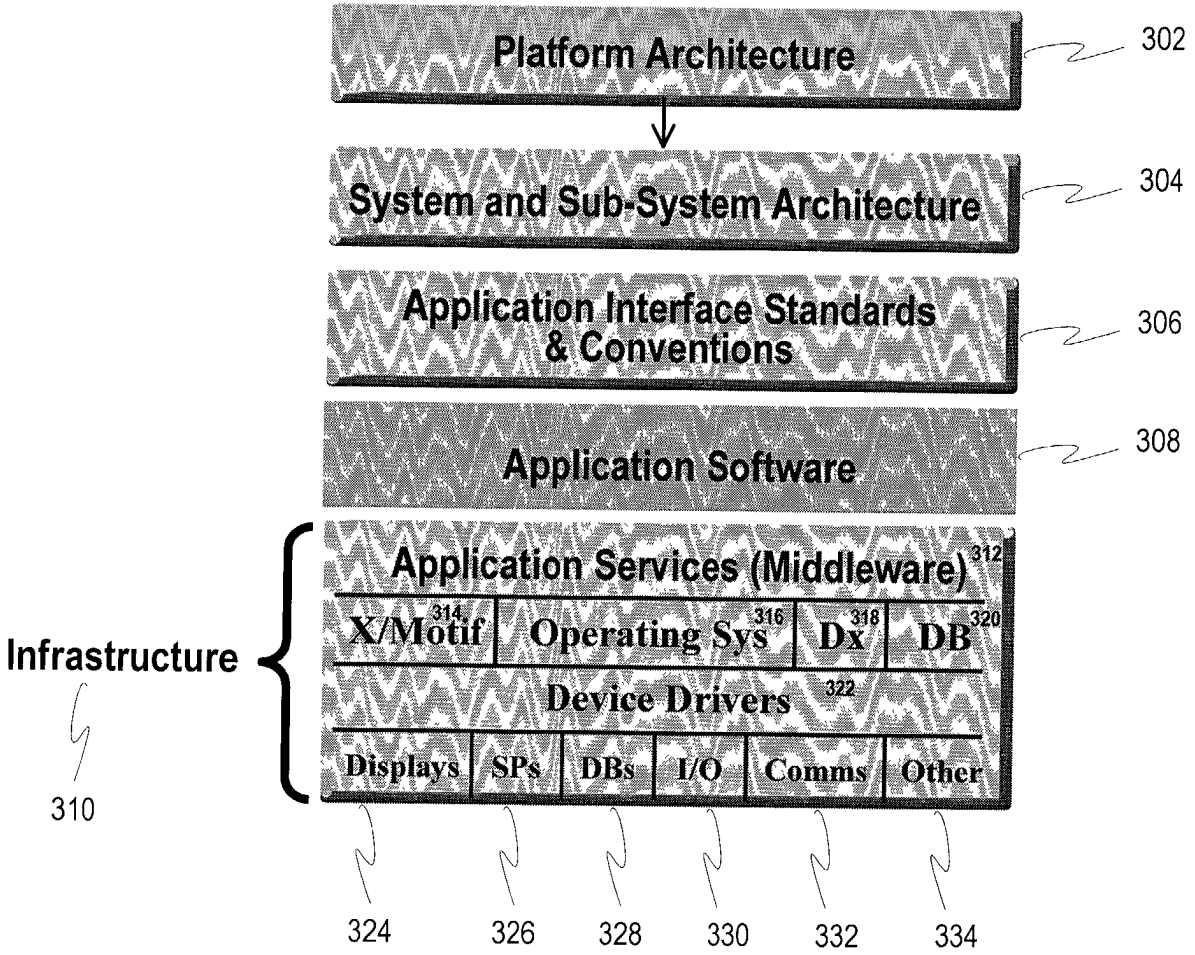
Platform Architecture
302
System and Sub-System Architecture
304
Application Interface Standards & Conventions
306
Application Software
308
Application Services (Middleware)
312
X/Motif
314
Operating Sys
316
Dx
318
DB
320
Device Drivers
322
Displays
SPs
DBs
I/O
Comms
Other
Infrastructure
310
324
326
328
330
332
334

FIG. 3

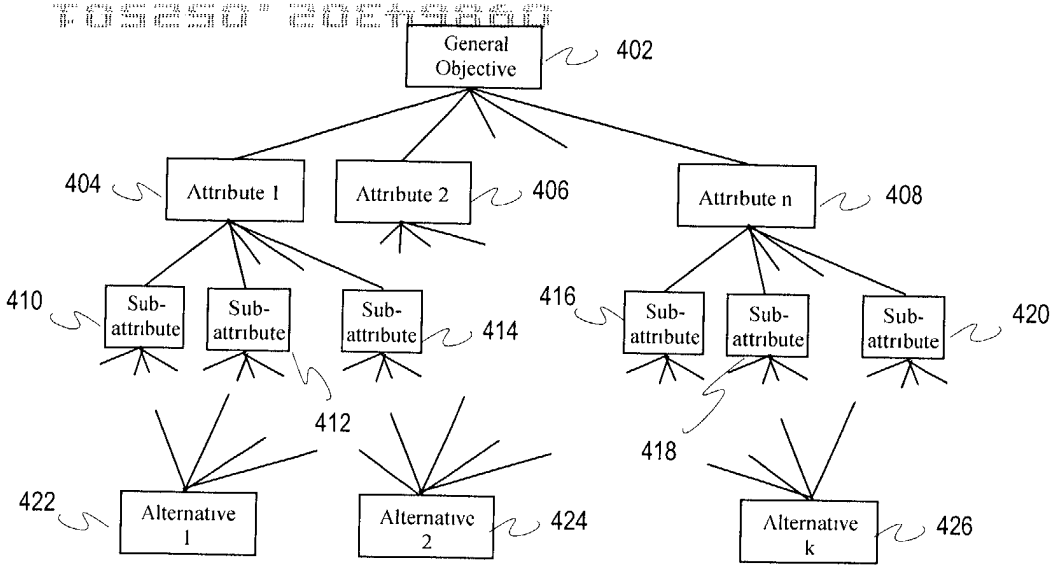
General Objective
402
Attribute 1
404
Attribute 2
406
Attribute n
408
Sub-attribute
410
Sub-attribute
Sub-attribute
414
412
Sub-attribute
416
Sub-attribute
Sub-attribute
420
418
Alternative 1
422
Alternative 2
424
Alternative k
426

FIG. 4

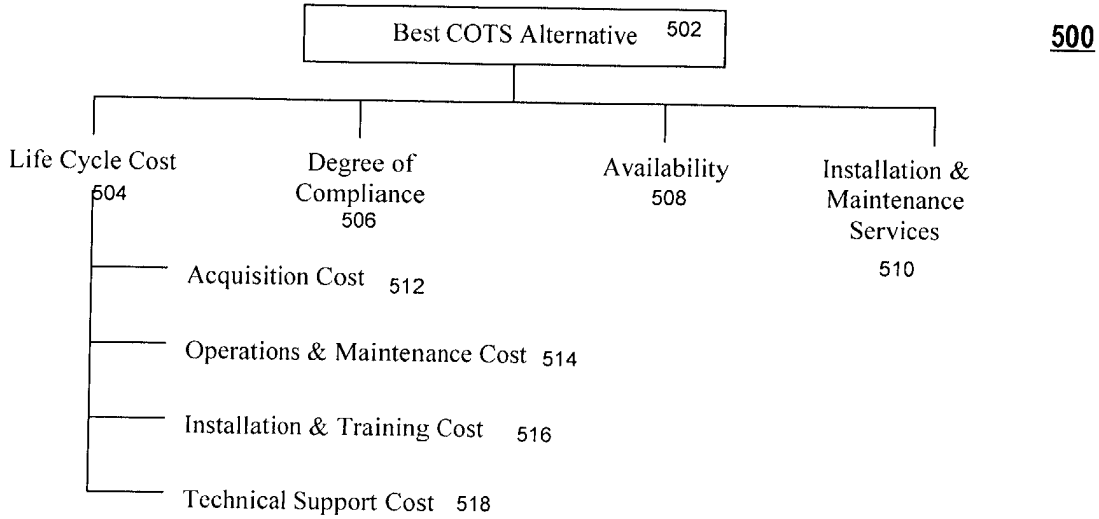
Best COTS Alternative 502
500
Life Cycle Cost 504
Degree of Compliance 506
Availability 508
Installation & Maintenance Services 510
Acquisition Cost 512
Operations & Maintenance Cost 514
Installation & Training Cost 516
Technical Support Cost 518

FIG. 5

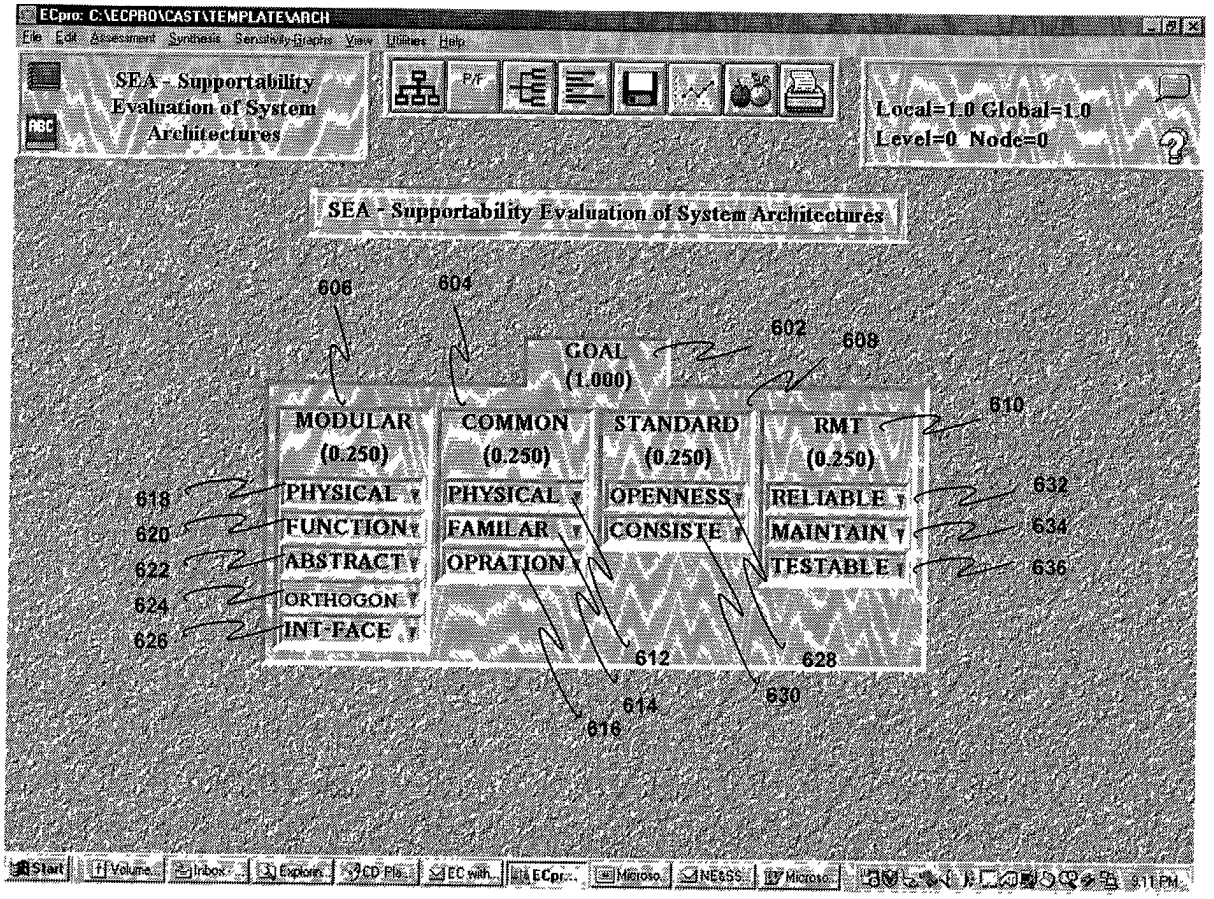
ECpro: C:\ECPRO\CAST\TEMPLATE\ARCH
File Edit Assessment Synthesis Sensitivity-Graphs View Utilities Help
SEA - Supportability Evaluation of System Architectures
Local=1.0 Global=1.0
Level=0 Node=0
SEA - Supportability Evaluation of System Architectures
606
604
602
608
GOAL
(1.000)
610
MODULAR
(0.250)
COMMON
(0.250)
STANDARD
(0.250)
RMT
(0.250)
618
620
622
624
626
PHYSICAL
FUNCTION
ABSTRACT
ORTHOGON
INT-FACE
PHYSICAL
FAMILAR
OPRATION
OPENNESS
CONSISTE
RELIABLE
MAINTAIN
TESTABLE
632
634
636
612
628
614
630
616
Start
3:11 PM

FIG. 6A

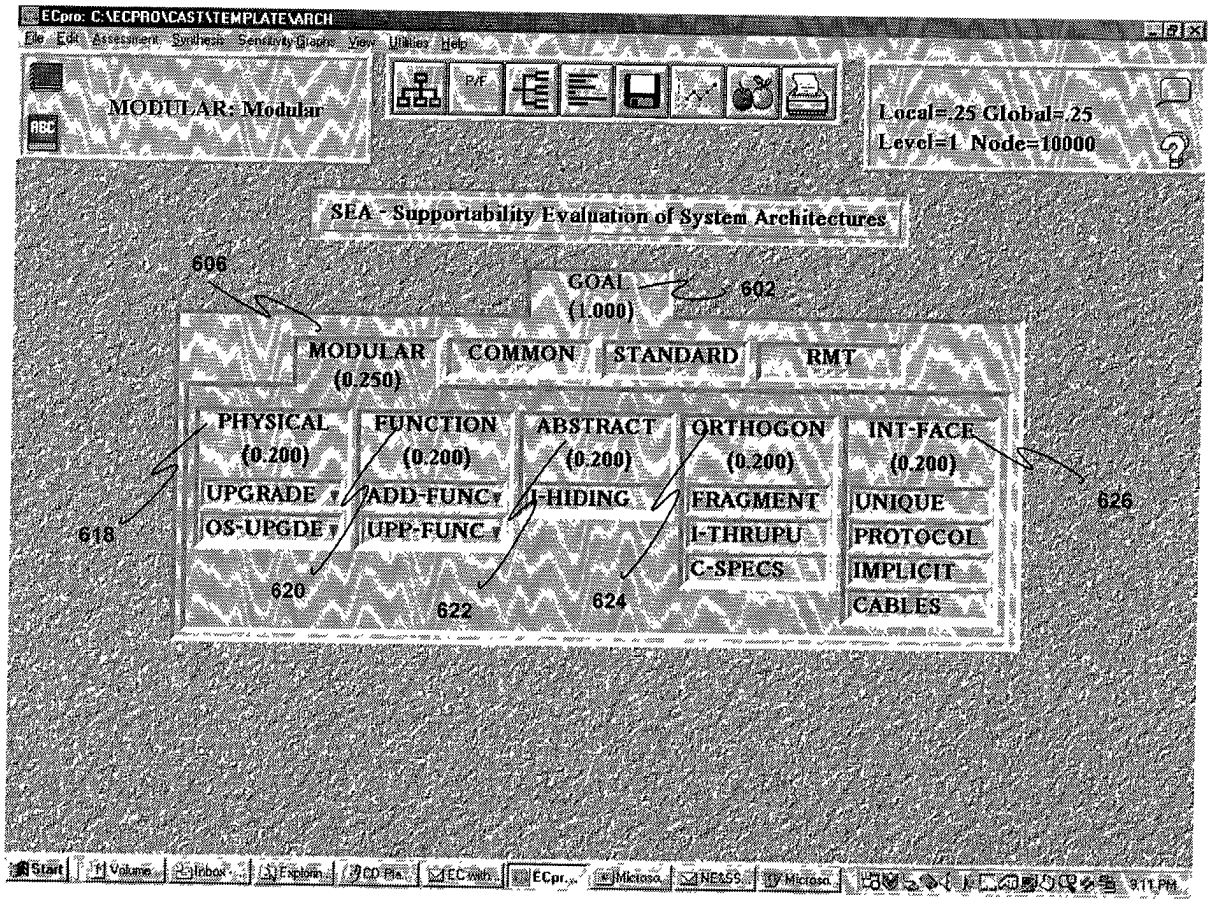
ECpro: C:\ECPRO\CAST\TEMPLATE\ARCH
File Edit Assessment Synthesis Sensitivity Graphs View Utilities Help
MODULAR: Modular
Local=.25 Global=.25
Level=1 Node=10000
SEA - Supportability Evaluation of System Architectures
606
GOAL
(1.000)
602
MODULAR
(0.250)
COMMON
STANDARD
RMT
PHYSICAL
(0.200)
FUNCTION
(0.200)
ABSTRACT
(0.200)
ORTHOGON
(0.200)
INT-FACE
(0.200)
UPGRADE
OS-UPGDE
ADD-FUNC
UPP-FUNC
I-HIDING
FRAGMENT
I-THRUPU
C-SPECS
UNIQUE
PROTOCOL
IMPLICIT
CABLES
618
620
622
624
626

FIG. 6B

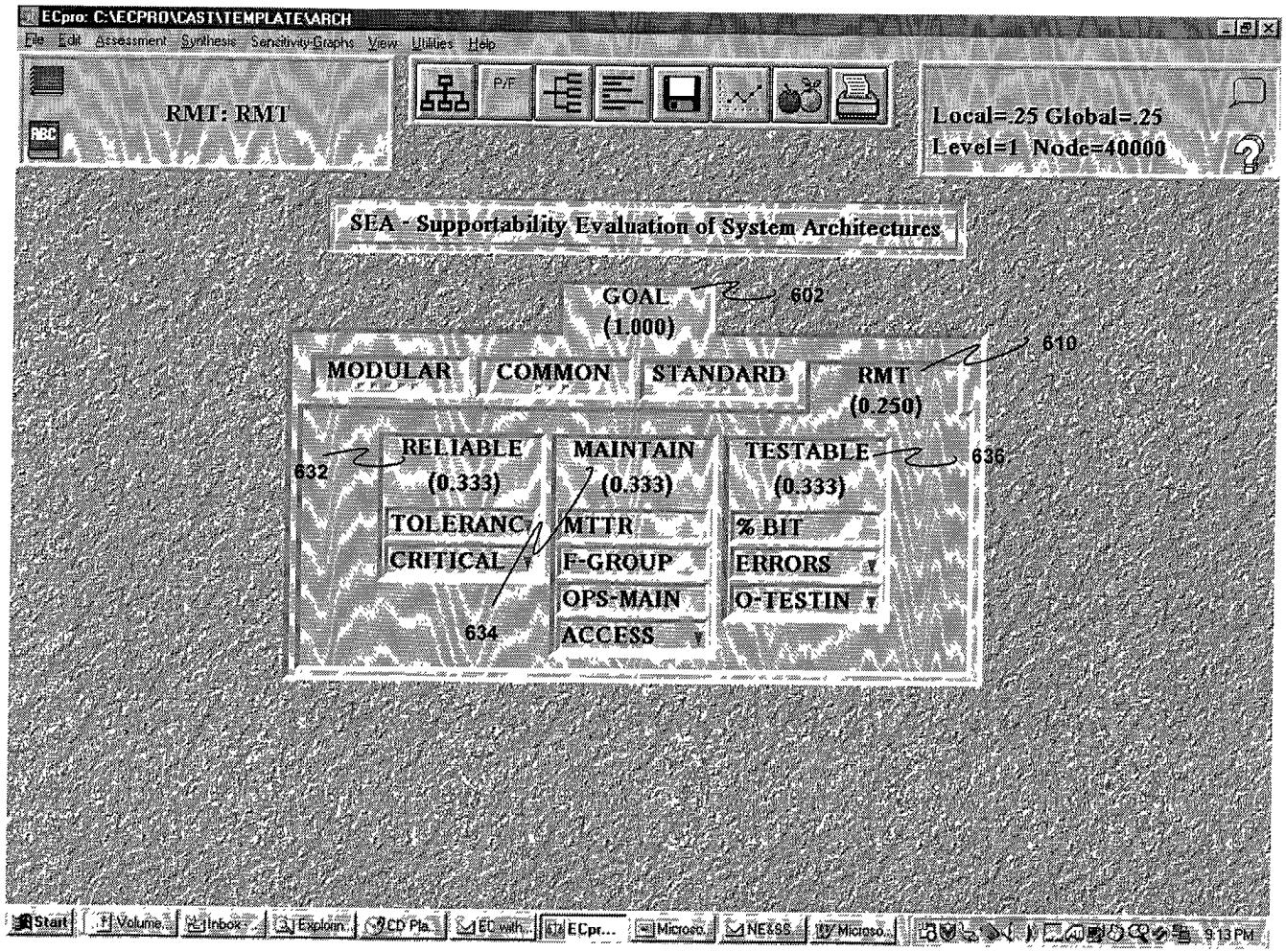
ECpro: C:\ECPRO\CAST\TEMPLATE\ARCH
File Edit Assessment Synthesis Sensitivity-Graphs View Utilities Help
RMT: RMT
Local=.25 Global=.25
Level=1 Node=40000
SEA - Supportability Evaluation of System Architectures
GOAL
(1.000)
602
610
MODULAR
COMMON
STANDARD
RMT
(0.250)
632
RELIABLE
(0.333)
MAINTAIN
(0.333)
TESTABLE
(0.333)
636
TOLERANC
CRITICAL
MTTR
F-GROUP
OPS-MAIN
ACCESS
% BIT
ERRORS
O-TESTIN
634
Start
9:13 PM

FIG. 6C

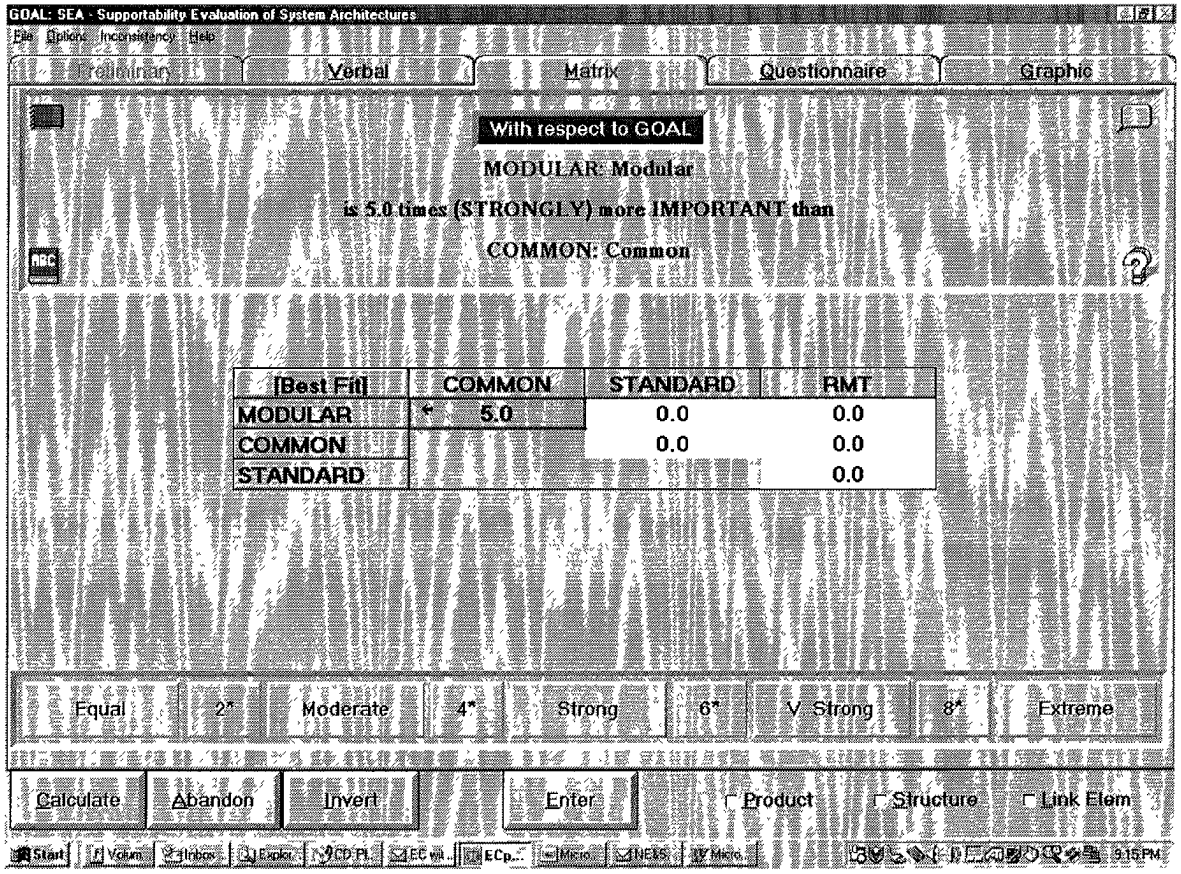
GOAL: SEA - Supportability Evaluation of System Architectures
File Options Inconsistency Help
Preliminary
Verbal
Matrix
Questionnaire
Graphic
With respect to GOAL
MODULAR: Modular
is 5.0 times (STRONGLY) more IMPORTANT than
COMMON: Common
[Best Fit]
COMMON
STANDARD
RMT
MODULAR
5.0
0.0
0.0
COMMON
0.0
0.0
STANDARD
0.0
Equal
2*
Moderate
4*
Strong
6*
V. Strong
8*
Extreme
Calculate
Abandon
Invert
Enter
Product
Structure
Link Elem
Start
9:16PM

FIG. 6D